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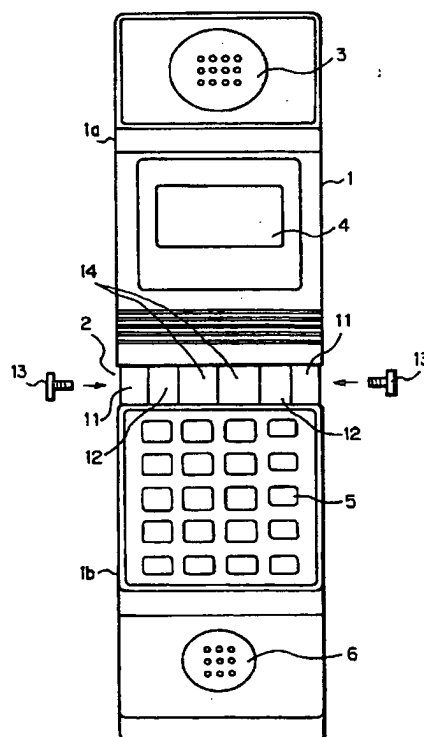
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(54) Electronic apparatus having a hinge structure

(57) In an electronic apparatus having a first and a second casing part, when the casing parts are rotated relative to each other about a hinge structure, a first and a second sleeve constituting a connector are also rotated relative to each other. A flexible conductive member is received in the sleeves so as to set up electrical connection between circuit portions built in the casing parts. The connector is removable from the circuit portions of the casing parts. Upon assembly, the electrical connection is set up only if the connector is connected to the circuit portions.

Fig. 1



EP 0 720 339 A2

## Description

The present invention relates to electronic apparatus having a plurality of casing parts and a hinge structure, whereby the casing parts may be connected mechanically and electrically to each other.

Today, with the advance of the miniaturization of electronic circuits, various kinds of electronic apparatus including desktop calculators and portable radio apparatus are available in sizes small enough to be put even in the pockets of clothing. However, miniaturization reduces the area available for keys, a display and so forth and thereby makes manoeuvrability and flexibility more difficult. In order to solve this problem, the apparatus may have a foldable configuration including a hinge structure, as has been proposed in various forms in the past. Specifically, the apparatus may include a plurality of casing parts hinged together in such a way that they can be unfolded to a size sufficient to make the manipulation of the apparatus more easy.

The prerequisite with such a foldable apparatus is that the hinge should provide an electrical connection between the plurality of casing parts. To meet this requirement, hinge structures capable of electrically connecting the housing parts have been proposed. For example, to connect electrically circuit portions disposed between two casing parts, use may be made of a flexible printed circuit board wrapped around a pin included in a hinge portion, or a signal line, as taught in Japanese Patent Laid-Open Publication No. 62-91867 by way of example. However, this kind of hinge structure, particularly one using a flexible printed circuit board, requires complicated assembly work and expertise, and there is only a limited efficiency of assembly.

In light of the above, it has been proposed that two casing parts be directly connected by connectors. For example, Japanese Patent Laid-Open Publication No. 5-197447 disclose a connector structure applied to a laptop personal computer. The laptop personal computer is made up of a body and a flat panel type display unit. The body and display unit are each provided with a respective connector. The connectors are removably coupled to each other so as to directly connect the body and the display unit mechanically and electrically. However, because this kind of structure is not intended to implement a hinge structure, it is difficult to use the structure as a hinge structure for rotatably connecting the body and display unit. Although such a connector structure may be so configured as to rotatably connect the body and display unit, it must support them mechanically. This brings about another problem in relation to the mechanical strength of the assembly.

Hence, a flexible printed circuit board is essential with a hinge structure of the kind which mechanically and electrically connects the body and the display unit. Therefore, such an assembly requires a great number of time consuming steps to produce.

Features of arrangements to be described below and illustrative of the present invention are that they provide

an improved hinge structure capable of setting up electrical connection and giving mechanical strength, while reducing the number of assembly steps required in manufacture.

An electronic apparatus to be described below and illustrative of the present invention has a first and a second casing part each accommodating a respective circuit portion therein. A hinge structure connects mechanically the first and second casing parts such that they are rotatable relative to each other, and the circuit portions electrically. The hinge structure has a connector removably connected to the circuit portions.

The following description and drawings disclose previously proposed arrangements and, by means of an example, the invention which is characterised in the appended claims, whose terms determine the extent of the protection conferred hereby.

In the drawings:-

FIG. 1 is a front view of a portable telephone to which a hinge structure illustrative of the present invention is applied,

FIG. 2 is a side elevation, as viewed from the left, showing the internal arrangement of the arrangement of Fig. 1,

FIG. 3 is a fragmentary exploded front view of the arrangement of Fig. 1,

FIG. 4 is a side elevation, as viewed from the left, showing the arrangement in an exploded condition, FIG. 5 is an exploded perspective view of a hinge connector included in the embodiment arrangement of Fig. 1,

FIG. 6 is a view showing that an upper casing part included in the arrangement of Fig. 1 is replaceable, FIG. 7 is an exploded perspective view of a previously proposed hinge structure applied to an electronic apparatus, and

FIG. 8 is a perspective view of a previously proposed connector structure applied to a personal computer.

To better understand the present invention, a brief reference will be made to a previously proposed hinge structure for rotatably and electrically connecting two casing parts, shown in FIG. 7. As shown, two casing parts 101 and 102 have two bearings 103 and two bearings 104, respectively. A threaded pin 105 is passed through the aligned holes of the bearings 103 and 104. A nut 105a is held in threaded engagement with the pin 105 in order to prevent it from slipping out of the bearings 103 and 104. Circuit portions 106 and 107 are mounted on the casing parts 101 and 102, respectively. A flexible printed circuit board 108 has its intermediate portion wrapped around the pin 105 by one turn, and its opposite ends soldered or otherwise connected to the circuit portions 106 and 107. Receiving portions 109 and 110 having a semicircular cross-section protrude from the casing parts 101 and 102, respectively. The receiving portions 109 and 110 and covers 111 and 112 cover the circuit board 108, thereby protecting it from damage. The cov-

ers 111 and 112 are respectively affixed to the casing parts 101 and 102 by screws 113, adhesive, or similar affixing means.

The problem with the above hinge structure is that the assembly work is complicated and needs expertise, as mentioned earlier. In addition, the efficiency of assembly is extremely low. Specifically, it is necessary to pass the pin 105 through one of the bearings 103 and 104, wrap the flexible circuit board 108 around the pin 105, solder or otherwise connect the opposite ends of the circuit board 108 to the circuit portions 106 and 107, pass the pin 105 through the other bearing 103 or 104 while maintaining the connection of the circuit board 108 to the circuit portions 106 and 107, and then fit the nut 105a on the pin 105. Further, it is necessary to affix the covers 111 and 112 to the casing parts 101 and 102 by screws or adhesive.

FIG. 8 shows a previously proposed connector structure able to obviate the complications of the assembly and disclosed in previously mentioned Japanese Patent Laid-Open Publication No. 5-197447. As shown, a laptop personal computer is made up of a body 201 and a flat panel type display unit 203. The body 201 and the display unit 203 are provided with connectors 202 and 204, respectively. The connectors 202 and 204 are removably coupled to each other so as to connect the body 201 and the display unit 203 directly mechanically and electrically. However, because this kind of structure is not intended to implement a hinge structure, it is difficult to use the structure as a hinge structure for rotatably connecting the body 201 and the display unit 203. Although such a connector structure may be so configured as to connect the body 201 and the display unit 203 rotatably, it must support them mechanically. This brings about another problem concerning the mechanical strength of the structure.

Referring to FIGS. 1 and 2, a hinge structure illustrative of the present invention is shown and applied to a foldable portable telephone by way of example. As shown, the telephone has an upper casing part 1a and a lower casing part 1b. The upper casing part 1a is rotatably connected to the top of the lower casing part 1b by a hinge portion 2. A receiver 3 and a display 4 are arranged on the front of the casing part 1a while various keys 5 and a transmitter 6 are arranged on the casing part 1b. When the telephone is used, the casing parts 1a and 1b are unfolded or opened about the hinge portion 2 to a position indicated by a solid line in FIG. 2. When the telephone is not used, the casing parts 1a and 1b are folded to a position indicated by a phantom line in FIG. 2.

The casing parts 1a and 1b and hinge portion 2 are shown in a separated condition in FIGS. 3 and 4. As shown, a pair of upper bearings 11 protrude from opposite sides of the casing part 1a. Likewise, a pair of lower bearings 12 protrude from opposite sides of the other casing part 1b. The lower bearings 12 are positioned inboard of the upper bearings 11. As shown in FIG. 11, screws 13 are respectively passed through the bearings

11 protruding from the casing part 1a, and then threaded into the bearings 12 inboard of the bearings 11. As a result, the casing parts 1a and 1b are hinged, e.g., rotatably connected to each other by the screws 13.

A hinge connector 14 is supported by the casing part 1b between the pair of bearings 12. As shown in an exploded view in FIG. 5, the hinge connector 14 is made up of a pair of sleeves 15 and 16 which are separate in the axial direction of the connector 14. Trough-like coupling portions 17 and 18 respectively protrude from the sleeves 15 and 16 substantially in the radial direction and extend in the axial direction of the connector 14. The coupling portions 17 and 18 are adaptive to, e.g., PCMCIA slots. A flexible printed circuit board 19 has its intermediate portion bent and received in the sleeves 15 and 16. Opposite ends of the circuit board 19 are implemented as PCMCIA connectors 20 and 21 and respectively received in and affixed to the coupling portions 17 and 18. The sleeves 15 and 16 are each formed with a slit 22 (only the slit 22 of the sleeve 15 is visible) for inserting the circuit board 19, locking pieces 23 (only the pieces 23 of the sleeve 15 are visible) for locking the sleeves 15 and 16 to each other in the axial direction while allowing them to freely move about the axis of the connector 14, and a stub 24 (only the stub 24 of the sleeve 16 is visible) for journaling the sleeves 15 and 16 to the bearings 12.

As shown in FIG. 4, a circuit board 30 is disposed in the casing part 1a while a connector 31 is mounted on the board 30 in the vicinity of the hinge portion 2. A slit 32 (see FIG. 3) is formed in the casing part 1a between the bearings 11, so that the connector 31 is accessible via the slit 32. Likewise, a circuit board 33 is disposed in the casing part 1b while a connector 34 is mounted on the board 33 in the vicinity of the hinge portion 2. A slit 35 is formed in the casing part 1b between the bearings 12, so that the connector 34 is accessible via the slit 35.

The above hinge structure is assembled by the following procedure. First, the sleeves 15 and 16 of the hinge connector 14 are put together in a coaxial condition. Then, the connector 14 is positioned between the bearings 12 and journalled thereto at its stubs 24. The coupling portion 17 is inserted into the casing part 1b via the slit 35 so as to connect one connector 21 of the flexible circuit board 19 to the connector 34. As a result, the circuit board 19 is electrically connected to the circuit board 33 disposed in the casing part 1b.

Subsequently, the bearings 11 of the casing part 1a are positioned at both sides of the bearings 12. Then, the bearings 11 and 12, i.e., casing parts 1a and 1b are connected together by the screws 13, as stated earlier. At this instant, the other coupling portion 18 of the hinge connector 14 is inserted into the slit 32 of the casing part 1a so as to connect the other connector 20 of the flexible printed circuit board 19 to the connector 31. This electrically connects the circuit board 19 to the circuit board 30 disposed in the casing part 1a. Consequently, the circuit boards 30 and 33 are electrically connected to each other by the hinge connector 14.

In practice, when the casing parts 1a and 1b are folded or unfolded about the hinge portion 2, the sleeves 16 and 15 whose coupling portions 18 and 17 are received in the housing parts 1a and 1b are rotated relative to each other. Although this relative rotation exerts a force on the flexible printed circuit board 19, the board 19 can follow the relative rotation because its intermediate portion is turned and has a sufficient dimensional margin.

As stated above, the hinge structure connecting the casing parts 1a and 1b is implemented by the bearings 11 and 12 formed integrally with the parts 1a and 1b, respectively, and the screws 13 connected the bearings 11 and 12. This kind of structure has great mechanical strength. As to the electrical connection of the casing parts 1a and 1b, the coupling portions 18 and 17 of the hinge connector 14 are respectively received in the slits 32 and 35 of the casing parts 1a and 1b, so that the connectors 20 and 21 of the flexible circuit board 19 are connected to the connectors 31 and 34, respectively. This eliminates the need for soldering or similar affixing means and thereby reduces the number of assembling steps, i.e., simplifies the assembly.

If the connectors 31 and 34 built in the casing parts 1a and 1b are standardized, then the casing part 1a can be easily replaced with another casing part identical in contour and hinge portion, but different in function. Specifically, FIG. 6 shows an upper casing 1A having the display 4 and speaker 3, an upper casing 1B having only the speaker 3, and an upper casing 1C having the display 4, speaker 3, and keys 5. In this manner, the portable telephone can be provided with a desired one of a broad range of configurations.

While the illustrative embodiment is applied to a portable telephone foldable in two, the present invention is practicable with any kind of electronic apparatus so long as the apparatus is foldable in two, three or more. Also, the present invention is applicable not only to a portable radio apparatus but also to a laptop personal computer or word processor or similar electronic apparatus having a hinge structure.

In summary, there has been described an electronic apparatus which has a first and a second casing part connected together by a hinge structure, and a connector removably connected to circuit portions disposed in the two casing parts. The connector is implemented as a hinge structure rotatable in unison with the relative rotation of the casing parts. When the casing parts are rotated relative to each other about the hinge structure, two sleeves constituting the connector are also rotated relative to each other. A flexible conductive member is disposed in the sleeves so as to electrically connect the circuit portions of the casing parts. Hence, the hinge structure guarantees the mechanical strength of the casing parts. At the same time, because the connector is removable from the circuit portions of the casing parts, the casing parts can be mechanically and electrically connected together only if the connector is connected to

the casing parts. This simplifies the assembly to a significant degree.

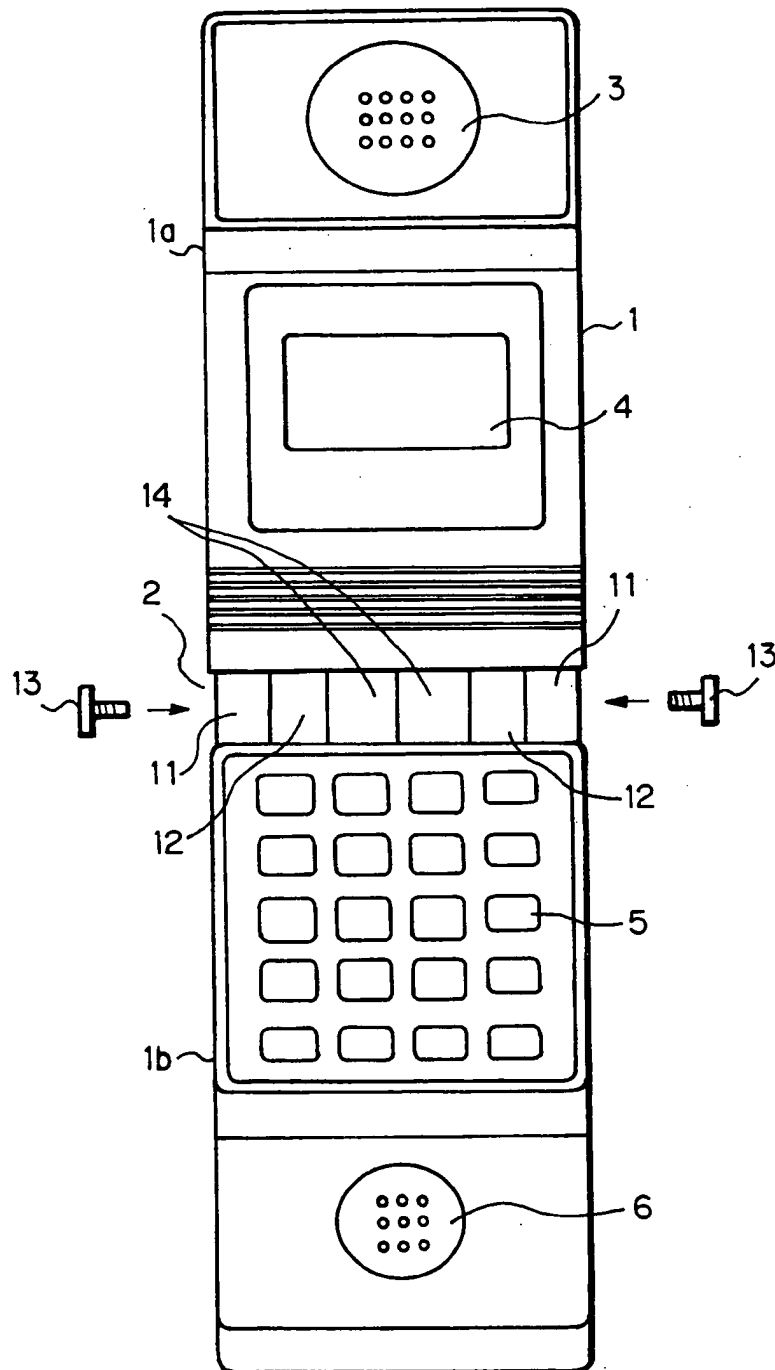
Various modifications will become possible for those skilled in the art after receiving the teachings of the present disclosure without departing from the scope thereof.

It will be understood that, although the invention has been illustrated with respect to particular embodiments, by way of example, variations and modifications thereof, as well as other embodiments may be made within the scope of the protection sought by the appended claims.

#### Claims

1. An electronic apparatus including a first casing part and a second casing part, each part accommodating a respective circuit portion therein, and a hinge structure connecting the first casing part and the second casing part such that the casing parts are rotatable relative to each other, and the circuit portions are electrically connected, the hinge structure including a connector removably connected to the circuit portions.
2. An apparatus as claimed in claim 1, wherein the connector includes a first sleeve connected to the circuit portion of one of the first casing part and the second casing part, and a second sleeve connected to the circuit portion of the other of the first casing part and the second casing part, wherein the first sleeve and the second sleeve are rotatable relative to each other about an axis of the hinge structure, and wherein a flexible conductive member for electrically connecting the circuit portions to each other is received in the first sleeve and the second sleeve.
3. An apparatus as claimed in claim 2, wherein the first casing part and the second casing part include respective bearings connected together by screws, and wherein the first sleeve and the second sleeve are positioned coaxially with and between the bearings.
4. An apparatus as claimed in claim 2, wherein the flexible conductive member includes a flexible printed circuit board removably connected to connectors provided in the first casing part and the second casing part, and wherein the first sleeve and the second sleeve have respective coupling portions for respectively receiving and supporting opposite ends of the flexible printed circuit board.

*Fig. 1*



*Fig. 2*

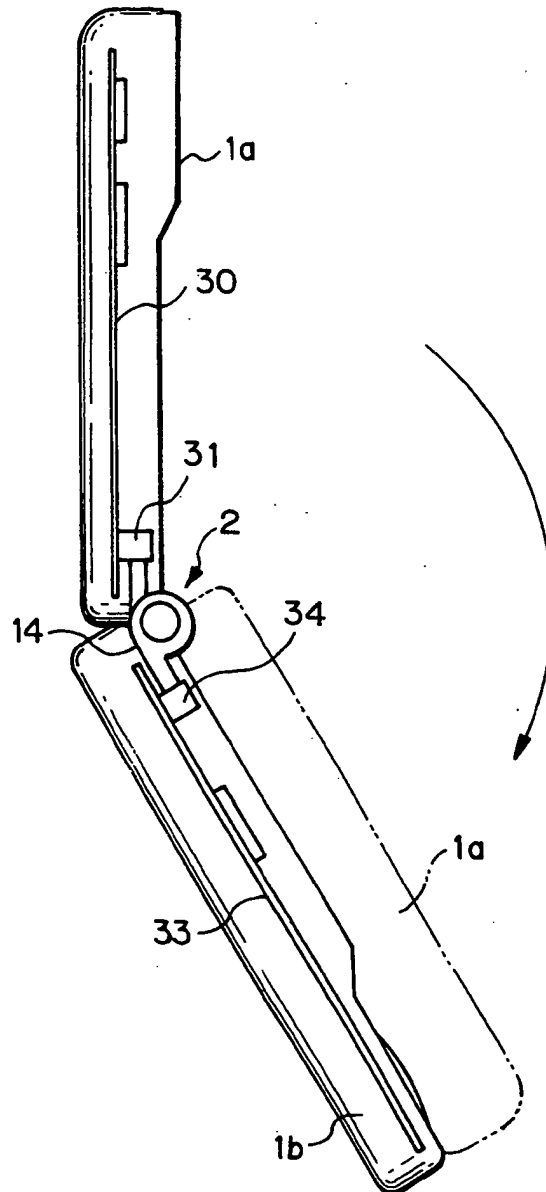


Fig. 3

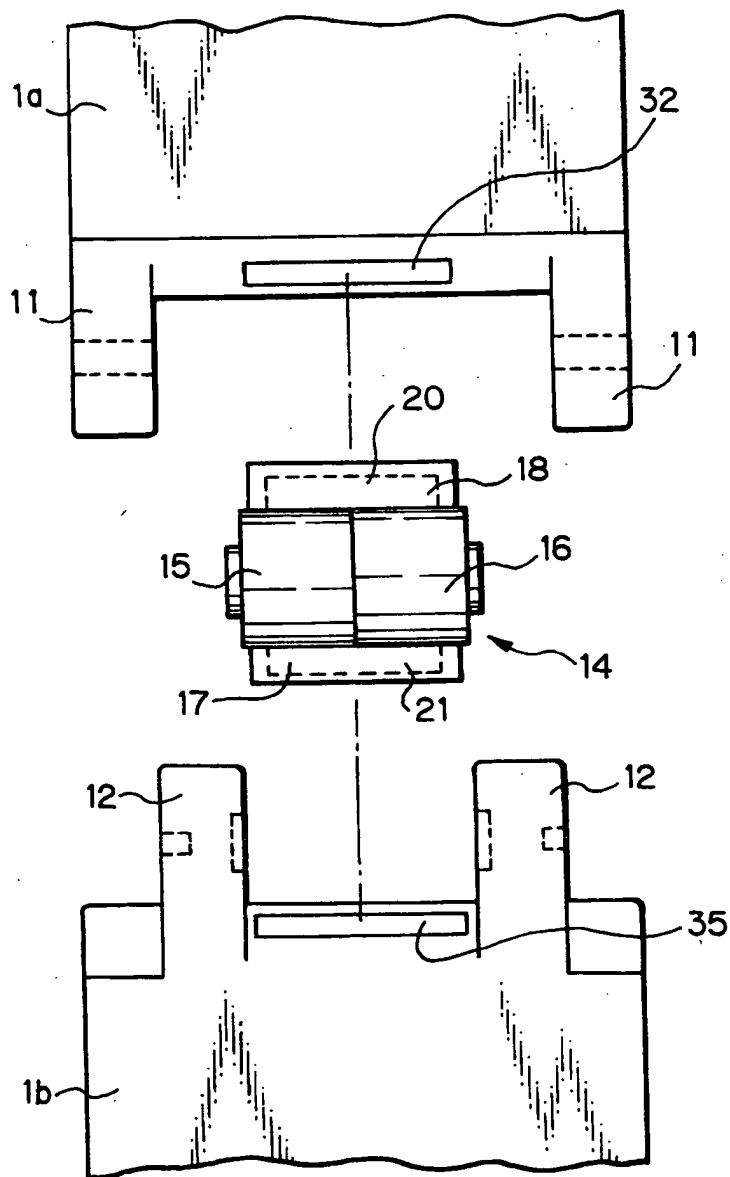


Fig. 4

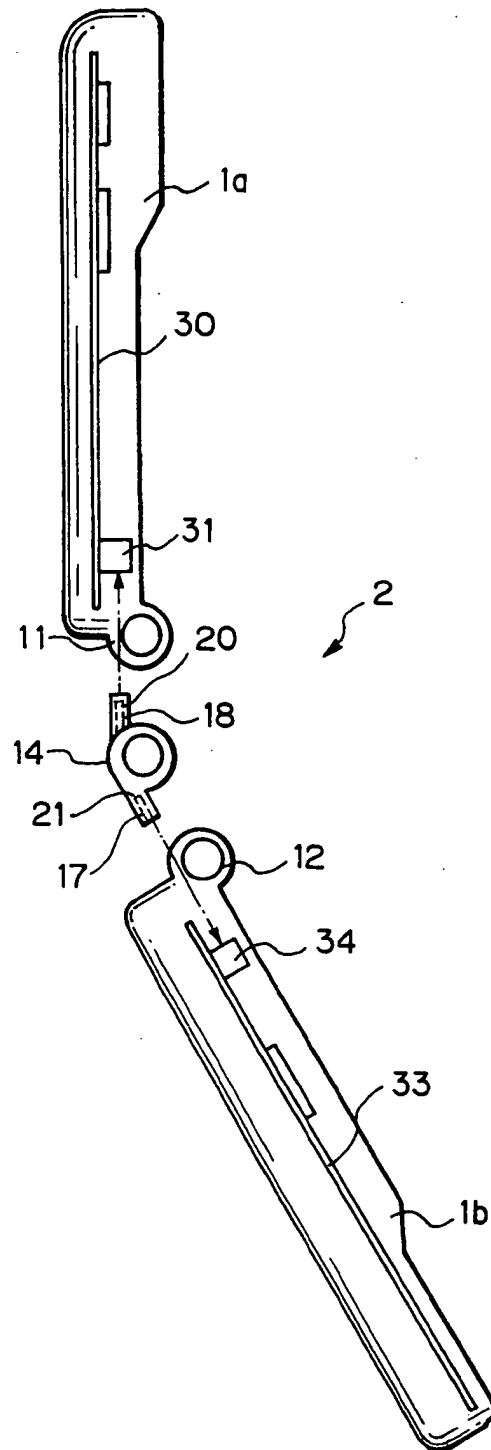
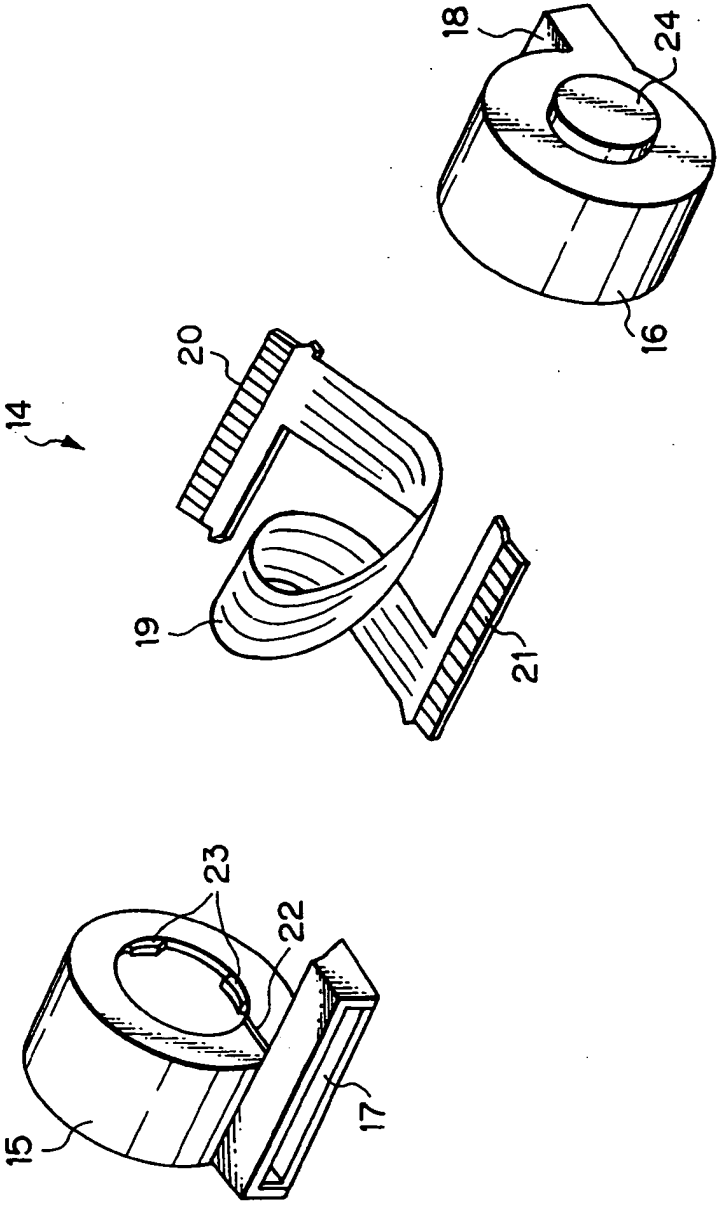




Fig. 5



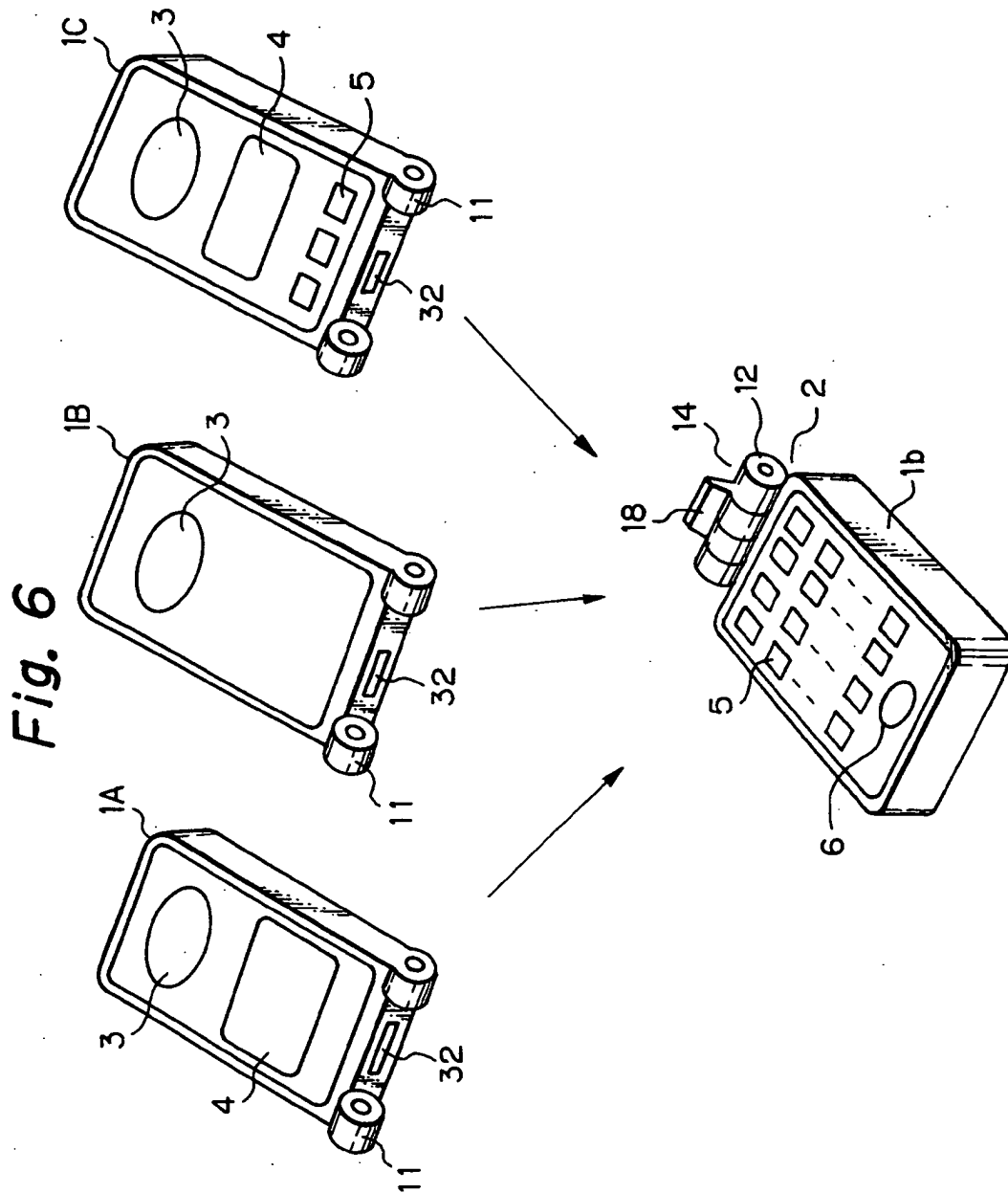
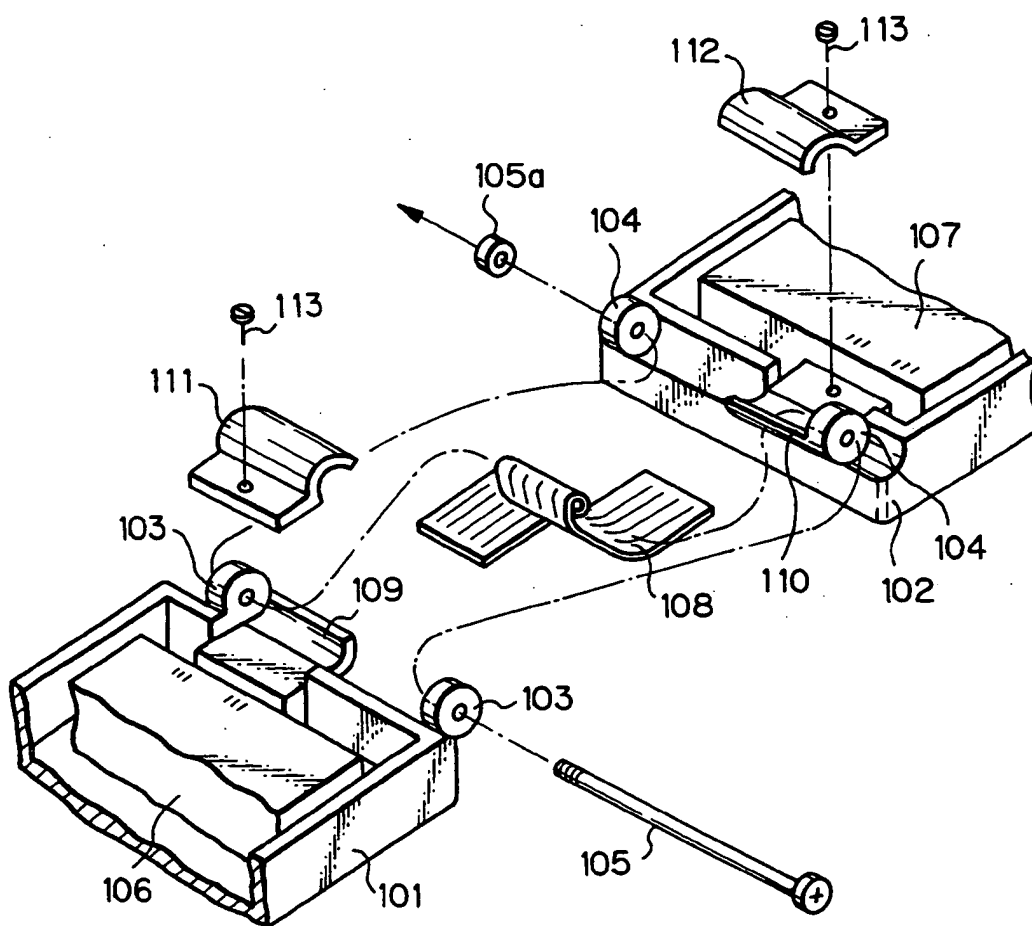
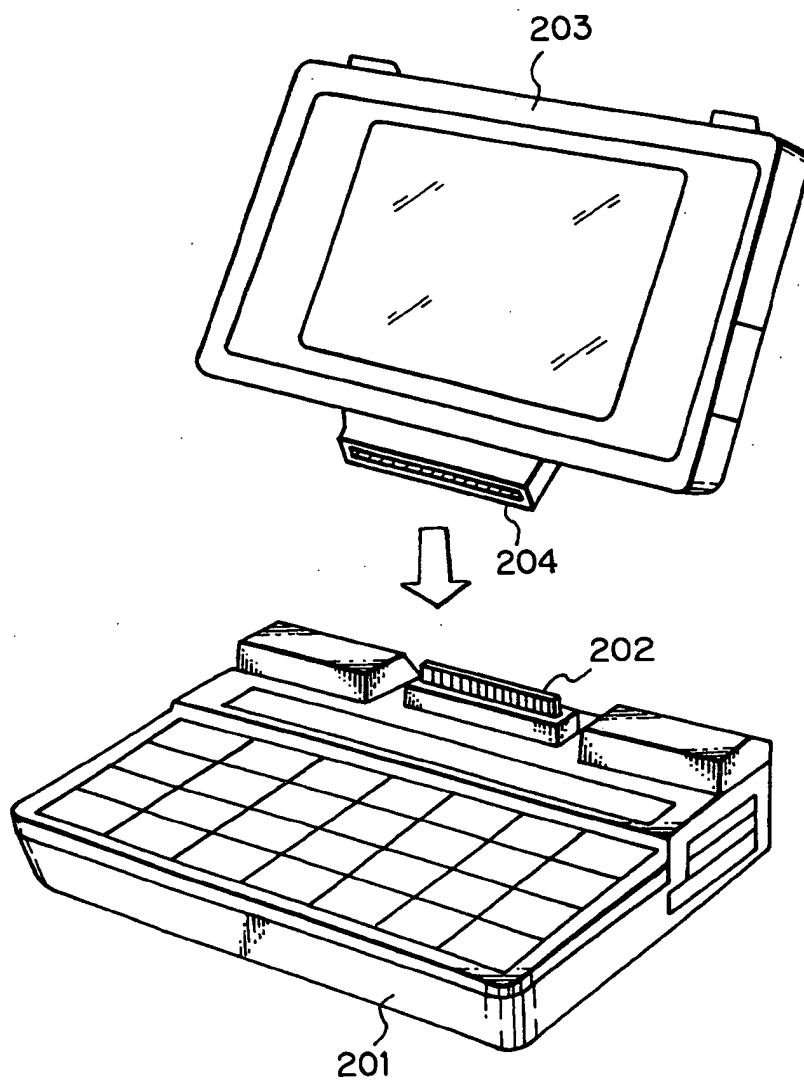
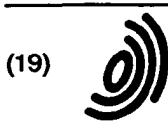


Fig. 7



*Fig. 8*





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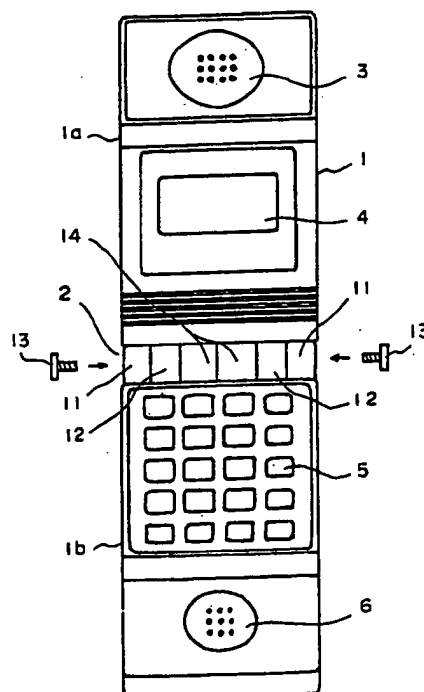
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FIG. 1



EP 0 720 339 A3



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# EUROPEAN SEARCH REPORT

Application Number  
EP 95 30 9528

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 5 547 144 A (SAKAMOTO YOSHITO ET AL) 20 August 1996	1,2,4	H04M1/02 H01R35/00 E05D11/00
Y	* column 2, line 25 - column 3, line 2; figure 1 *	3	
Y	EP 0 535 912 A (NIPPON ELECTRIC CO) 7 April 1993 * figure 3 *	3	
X	US 5 328 379 A (KOBAYASHI TAKAICHI) 12 July 1994 * figure 3 *	1	
X	US 5 001 659 A (WATABE NOBORU) 19 March 1991 * column 3, line 26 - line 61; figures 3,4 *	1	
Y	US 5 141 446 A (OZOUF RENE ET AL) 25 August 1992 * figure 2 *	1	
Y	"FLEXIBLE INTERFACE CABLE FOR PORTABLE PC" IBM TECHNICAL DISCLOSURE BULLETIN, vol. 37, no. 11, 1 November 1994, page 179/180 XP000487205 * figure 1 *	1	TECHNICAL FIELDS SEARCHED (Int.Cl.6)  H01R E05D H04M G06F
E	GB 2 295 850 A (JAPAN AVIATION ELECTRON ;NIPPON ELECTRIC CO (JP)) 12 June 1996 * page 8, paragraph 1 - paragraph 3; figures 1,2 *	1,2,4	
The present search report has been drawn up for all claims			
Place of search <b>THE HAGUE</b>		Date of completion of the search <b>2 December 1998</b>	Examiner <b>Willems, B</b>
<p><b>CATEGORY OF CITED DOCUMENTS</b></p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons &amp; : member of the same patent family, corresponding document</p>			

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